RESISTANCE OF IMMATURE MANGO FRUITS TO CARIBBEAN FRUIT FLY (DIPTERA: TEPHRITIDAE)

MICHAEL K. HENNESSEY[1] AND R. J. SCHNELL[2]
[1]U. S. Environmental Protection Agency, Office of Pesticide Programs
12000 Pennsylvania Avenue NW, Mailbox 7503C, Washington, DC 20460

[2]USDA-ARS, Subtropical Horticulture Research Station, 13601 Old Cutler Road, Miami, FL 33158

Both mature and immature mangoes, *Mangifera indica* L., grown in subtropical Florida are marketed. Food use of immature mangoes includes being cooked for sauce, powdered for a flavoring agent, pickled, and processed into chutney. Immature mangoes are distinguished from mature mangoes in that they do not ripen after harvest (Reid 1992). Immature mangoes have a whitish flesh, lack juiciness, and have a sour flavor, while mature mangoes have yellow flesh, are juicy, and have a sweet flavor.

Mango has been listed as a host of Caribbean fruit fly, *Anastrepha suspensa* (Loew) (Norrbom & Kim 1988). California, where the largest immature mango market is, maintains a Caribbean fruit fly quarantine on both mature and immature imported mangoes. Mangoes can only be shipped from Florida to California if they have undergone an acceptable postharvest treatment that disinfests them of fruit flies.

To our knowledge, there have been no studies to determine to what extent immature mangoes may represent a lower risk for fruit fly infestation than mature mangoes. Peña & Moyhuddin (1997) reviewed mature mango fruit resistance to *Anastrepha obliqua* (Macquart) and infestability differences among cultivars were suggested to be caused by differences in toxic chemicals, nutrients, or resin ducts. Hennessey & Schnell (1995) determined that for mature fruit, some genotypes are more resistant to Caribbean fruit fly than others. They also suggested highly resistant germplasm accessions could be employed in breeding efforts and integrated pest management systems for control of Caribbean fruit flies. The present investigations were conducted to determine if some germplasm accessions in the immature state were more resistant to Caribbean fruit fly than others.

Fruits used in the experiments were from the USDA National Clonal Germplasm Repository at the Subtropical Horticulture Research Station in Miami, FL, where over 150 *Mangifera* accessions are maintained. The accessions comprise a valuable source of genetic diversity utilized by breeders and researchers from all over the world. Fruits from 18 *M. indica* accessions (individual trees) were selected based on availability and inclusion in a previous study of mature mangoes (Table 1). Immature mangoes were available from March 21 to June 23, 1996. Tree cultivation practices included fertilization, pruning, and chemical weed control. No insecticides were applied during testing and for at least four months prior to testing. The methods for rearing flies, determining mango maturity, and bioassaying of fruits were previously described in detail (Hennessey & Schnell 1995). Flies were reared on an agar-based diet (Hennessey 1994) which was used as the control in the present study. Stage of maturity of the mangoes was determined for each accession and harvest date by holding 5-10 fruits in the laboratory and observing flesh color, juiciness, and flavor after 5-8 days. Each accession was bioassayed on three dates: early (March-April), middle (May), and late (June) immature period (Table 1). Slices, including peel, from five fruits per accession were bioassayed for each date. Ten mature Caribbean fruit fly eggs were inoculated on each fruit slice and corresponding agar control portions. The corrected mean percentage adult emergence was the criterion used to evaluate resistance. This value was obtained by dividing the percentage of eggs reaching adulthood from each slice by the mean percentage reaching adulthood from five agar controls of the same date.

The experiment was completely randomized. Corrected mean percentage adult emergence data from the three harvest dates combined ($n = 15$) were analyzed with PROC ANOVA and compared among cultivars with the LSD test (SAS Institute 1992).

The corrected mean percentage of emergence of adult flies from mangoes varied from 0.0% for 'Saigon Seedling' M13269 to 35.7% for 'Keitt' (Table 1). The most resistant group included 15 cultivars that supported less than 28.9% emergence. Hennessey & Schnell (1995) observed that the corrected mean percentage emergence varied from 26.6% for mature 'Tobago Small Red' to 119.0% (a higher emergence rate than the control) for mature 'Sabre'. In that study, the group that contained the most resistant cultivar ($P = 0.10$) consisted of 'Peach', 'Irwin', 'Tommy Atkins', 'Rumani', 'Turpentine', 'Keitt', '13-1', 'Sandersha', 'Zilate', and 'Tobago Small Red' (Table 1). Mature mangoes served as a better substrate for development than did immature mangoes of the same cultivar. Over all cultivars, immature mangoes supported from 2-59% of the emergence compared with mature fruits of the same cultivars did. This could be interpreted to mean that, within cultivars, most immature man-

TABLE 1. MANGO CULTIVARS, SAMPLING DATES, AND CORRECTED MEAN PERCENTAGE ADULT CARIBBEAN FRUIT FLY EMERGENCE FROM IMMATURE AND MATURE MANGO FRUITS, MIAMI, FL.

		Sampling dates for immature mangoes			Mean % emergence (SEM)[1]	
Cultivar	Accession #	Early	Middle	Late	Immature mangoes	Mature mangoes[2]
'Keitt'	M17451	April 18	May 30	June 20	35.7a (15.9)	59.0b (6.7)
'S-10'	M22097	March 21	May 16	June 13	35.2a (20.9)	88.4a (9.7)
'Peach'	M14278	March 28	May 16	June 20	28.9ab (9.6)	76.8b (22.0)
'Winters'	M20222	April 4	May 9	June 6	23.9abc (13.0)	85.6a (16.2)
'Golek'	M12329	March 21	May 16	June 20	20.5abc (9.5)	92.4a (24.7)
'Sabre'	M14277	April 25	May 9	June 20	17.3abc (10.2)	119.0a[3] (27.1)
'Irwin'	M17452	April 18	May 23	June 20	14.3abc (7.1)	76.2b (24.3)
'Jo-Z'	M27187	April 25	May 30	June 20	13.8abc (7.7)	100.0a (17.5)
'Zilate'	M24476	April 11	May 23	June 13	13.7abc (5.8)	—
'Carabao'	M04336	April 11	May 2	June 6	7.0bc (7.0)	88.4a (9.7)
'13-1'	—	April 4	May 23	June 13	6.9bc (5.2)	—
'Eldon'	M19833	March 21	May 16	June 13	6.1bc (6.1)	92.2a (11.1)
'Aeromanis'	M12327	March 28	May 9	June 13	5.9bc (4.4)	80.8a (16.6)
'Rumani'	M17699	April 25	May 30	June 20	2.8c (2.0)	73.8b (9.3)
'Tommy Atkins'	M23457	April 4	May 9	June 6	2.7c (1.9)	76.0b (20.5)
'Turpentine'	—	March 28	May 2	June 13	1.5c (1.5)	65.2b (21.5)
'Becky'	M26401	April 16	May 23	June 23	1.1c (1.1)	38.4b (9.6)
'Saigon Seedling'	M13269	April 11	May 2	June 6	0.0c (0.0)	42.2b (16.6)

[1]Column means (n = 15) followed by the same letter do not differ (P = 0.05; LSD).
[2]Hennessey & Schnell (1995).
[3]Percentage emergence exceeded that for controls.

goes would present less than half the risk of introducing Caribbean fruit flies to an importing area than mature mangoes would.

Resistant cultivars may be coupled with other technology including monitoring traps and preharvest insecticide treatments in a systems approach to reduce fruit fly infestations to negligible levels, thus achieving quarantine security.

More information on the accessions used in the present studies may be obtained from the Germplasm Resources Information Network website http://www.ars-grin.gov. Propagative materials from the Miami collection are available free to researchers and breeders.

The authors thank P. Mendez, E. Schnell, and W. Wasik, USDA-ARS, Miami, FL, for their assistance in conducting the experiments, and R. J. Knight, Jr. (University of Florida, Homestead) and L. Chang (USDA-APHIS, Riverdale, MD) for reviewing the article.

SUMMARY

Immature mango slices were artificially infested with Caribbean fruit fly eggs in the laboratory. The mean percentage of emergence of adults, relative to emergence from control media, varied from 0.0% for 'Saigon Seedling' (M13269) to 35.7% for 'Keitt'. Immature mangoes supported only 2-59% of the emergence compared with mature fruits of the same cultivars. Resistant cultivars may possibly be coupled with preharvest insecticide treatments to reduce fruit fly infestations to below the level of quarantine concern.

REFERENCES

HENNESSEY, M. K. 1994. Depth of pupation of Caribbean fruit fly in soils in the laboratory. Environ. Entomol. 23: 1119-1123.

HENNESSEY, M. K., AND R. J. SCHNELL. 1995. Screening Florida mango fruits from germplasm for resistance to immature stages of Caribbean fruit fly. Insect Sci. Applic. 16: 119-121.

NORRBOM, A. L., AND K. C. KIM. 1988. A list of the reported host plants of *Anastrepha* (Diptera: Tephritidae). USDA, APHIS, PPQ Report 81-52. viii, 114 pp.

PEÑA, J. E., AND A. I. MOYHUDDIN. 1997. Insect Pests, p. 327-362. *In* R. E. Litz (ed.). The mango. CAB International, Wallingford, UK.

REID, M. S. 1992. Maturation and maturity indices, p. 21-28. *In* A. A. Kader (ed.). Postharvest technology for horticultural crops. Univ. California Div. Agric. and Natural Resources Publ. 3311.

SAS INSTITUTE, INC. 1992. SAS, version 6.04. SAS Institute, Cary, NC.